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*Observations on the distribution of certain Extinct Vertebrata in North Carolina.*

BY EDWARD D. COPE.

(Read before the American Philosophical Society, November 17, 1871).

DIODON L.

DIODON ANTIQUUS, Leidy. Proc. Acad. Nat. Sci.

Superior and inferior jaws from the Miocene. This fish was described from transported and much worn specimens from the Ashley River, South Carolina. The present specimens are unworn, and display the characters of the species. These are very much like those of the recent *D. filamentosus*. The species appears also to pertain to the horizon of the Miocene.

BELODON, Myr.

Teeth of both the smooth and fluted types were found by Prof. Kerr in Chatham Co., N. C. The latter (*B. carolinensis*, Emm.) appear also to occur in Wheatley's collection, from the Trias of Phoenixville, Penn. Three successive forms of the maxillary teeth of *B. priscus* are figured.

THECACHAMPSA, Cope.

THECACHAMPSA RUGOSA, Emmons.

*Polyptychodon rugosus*, Emmons, Geol. Surv. N. C.

Emmons' figure of this species is not distinguishable from a worn canine of a *Basilosaurus*, and as such I regarded it on a former occasion. An examination of a specimen received from Prof. Kerr, shows that its affinities are Crocodilian, and its structure similar to that of *Thecachampsa*, Cope. It is more strongly rugose-striate than in any of the known species, but is approached in rugosity by *Thecachampsa squankensis*, Marsh. The range of the genus is thus extended to N. Carolina.

CLEPSYSAURUS, Lea.

Teeth of this genus are very rare, one only having been observed by Dr. Lea. Prof. Emmons believed that he had discovered two species in the Trias of North Carolina, *C. pennsylvanicus* and *C. leaii*. The greater part of the remains on which these were based I have shown to be Belodonts, but one tooth figured by Emmons, N. C. Geol. Surv., Pl. V. f. 3, may belong to this genus.

Prof. Kerr's collection contains two teeth which are identical with that associated with the *C. pennsylvanicus* by Lea, one of them nearly perfect, the other the basal portion only. They exhibit two minutely denticulated cutting edges, separated by one-third of the circumference. This third is nearly flat, the remaining portion being very convex. One cutting edge extends to the base of the crown, the other occupies only the distal two-thirds. The section of the tooth would be round at the base were it not for the projection of the cutting edge. The enamel is minutely striate, under the glass. The base of the larger tooth measures .75 of an inch in diameter. The figure of Emmons leaves something to be desired, as he

does not represent the long cutting edge of the crown. His descriptions of the tooth appear to refer to this genus. Kerr's specimens are conclusive as to the extent of this formidable genus of carnivorous Dinosauria to N. Carolina.

#### ZATOMUS, Cope.

This genus embraces reptiles whose teeth are described and figured by Prof. Emmons, American Geology, Pt. VI. p. 62, fig. 34. He found them associated with radiate osseous plates (probably dermal) which he found on one occasion in connection with the cranium of the supposed Labyrinthodont, *Dictyocephalus elegans*, Leidy. Both the plates and teeth are too large to be associated with the latter, and the teeth especially remind one of the *Dinosauria*. Emmons describes a tooth in the following language:

"It is compressed, curved, finely serrate posteriorly, which appears to point to the apex, when seen so as to bring into view a slight wrinkle or groove at the base of each tooth. Its enamel covers the whole crown, or all above the part implanted or inserted. The enamel is finely or minutely wrinkled, and at the posterior edge, at the junction of the plates at each side, a faint groove remains; and the serræ appear like a double row, but near the apex they entirely disappear; the convex or anterior edge is smooth.

"The tooth appears much like the tooth of a *Megalosaurus* in miniature, though it is less curved. I have found only two teeth of this kind; the smallest is half the size of the one figured." This size is 0m. 022 in length; diameter at base .012.

In the section given by Emmons, one side of this tooth is a little more convex than the others.

The affinities of this genus appear to be to *Teratosaurus* and *Laelaps*. From both of these, as well as from *Megalosaurus*, it differs in the absence of serration from the anterior margin, and in the groove in the posterior cutting edge dividing it into two appressed serrate edges which disappear near the apex. The species may be called *Zatomus sarcophagus*. Its size about equalled large specimens of the Southern Alligator.

#### HYPSIBEMA, Cope.

Char. gen. Proportions of limbs and feet much as in *Hadrosaurus*. The caudal vertebræ elongate and depressed, in the median part of the series.

The elongate depressed form of caudal vertebræ, distinguishes this genus from *Hadrosaurus*. The latter possesses elongate vertebræ near the extremity of the series, but anterior to this point, they are first subquadrate in profile, then proximally much narrowed. The form exhibited by the known species of this genus is more like that of *Hylæosaurus* Mant.

#### HYPSIBEMA CRASSICAUDA, Cope.

The remains on which this species is founded consists of the distal extremity of the right humerus, a portion of the shaft of the left tibia, a

portion of the fibula, the right internal metatarsus somewhat broken, and a caudal vertebra. There are other uncharacteristic fragments, and a piece which may be a dermal bone.

Associated with them are several coprolites of large animals.

These species indicate an animal of about the size of the *Hadrosaurus foulkei*, Leidy, and with a similar disproportion in the lengths of the limbs.

This is readily appreciated on comparison of the huge metatarsus with the light humerus. The medullary cavity of the tibia is large; that of the humerus small.

The portion of the humerus preserved is injured, and the condyles are worn. Its relation to that of *H. foulkei* is readily determined, and on comparison the following marked differences appear: The ridge connecting the external condyle with the shaft posteriorly is acute; it is rounded in *H. foulkei*. External distal face is flat or slightly concave; in *H. foulkei* somewhat rounded. It is at right angles to the plane of the anterior face, and forms with it rather less than a right angle; in *H. foulkei* this region is rounded. Distally, the shaft is much flattened in *H. crassicauda*.

<i>Measurements.</i>	<i>Lines.</i>
Antero-posterior diameter of shaft, just above condyles....	20.5
Width external face distally.....	24.
“ olecranon fossa.....	16.
“ condyles, (estimated).....	64.

The anterior face at over three inches above the condyles is slightly concave. About 4.5 inches above the articular face of the external condyle, the acute ridge dividing the posterior and external faces disappears, and the surface becomes regularly rounded.

The portion of the tibia is from the shaft of that of the left side, just below the superior antero-posterior expansion. Therefore, the inner face is the most extensive, and the posterior the least so. It differs from the same part in *H. foulkei*, in its less angularity, especially in the more rounded, and less defined posterior face.

The internal face narrows downwards, and while the greater diameter of the fragment above is antero-posterior, below it is diagonal, the anterior point being the inner.

<i>Measurements.</i>	<i>Lines.</i>
Antero-posterior diameter above.....	48.
Transverse “ “ .....	22.5
“ “ medullary cavity.....	20.5

The portion of the fibula is the distal, and resembles that of *Hadrosaurus foulkei*, in being slightly expanded near the extremity, and cylindrical in the lower part of the shaft. In both genera and *Ornithotarsus*, Cope, the distal extremity of the fibula is less attenuated than in *Iguanodon*.

	<i>Lines.</i>
Transverse distal diameter.....	40.5
“ five inches above.....	30.

The right internal metatarsus also bears considerable resemblance to *H. foulkei*. Its proximal extremity is much more convex in its inner outline than in that species. The inner proximal face is plane and longitudinally wrinkled. The proximal or tarsal articular face is concave anteriorly; its plane is at right angles to the axis of the shaft of the bone. It is strongly oblique in *H. foulkei*, and a rib-like prominence of the outer face crosses the latter obliquely and at right angles to the proximal extremity. No such rib exists in the present case, because the weight was supported by the shaft of the bone, directly and not obliquely as in *Hadrosaurus*. Thus the *Hypsibemas* walked more exactly on the toes than did the *Hadrosauri*.

The posterior margin is thinner, and as in *H. foulkei*, presents a rather small median protuberance. The distal condyle is broken away, but the twist of the distal portion of the shaft shows that it was directed away from the adjoining metatarsal, posteriorly.

	<i>Measurements.</i>	<i>In.</i>	<i>Lines.</i>
Length from antero-superior to postero-inferior,		10	10
Extremity (inferior articular face worn away),			
Transverse diameter proximally.....		3	
“ “ medially.....		2	3.5
Antero-posterior diameter medially.....		3	6.

The diameters of the shaft are somewhat larger than in the *H. foulkei* given by Leidy.

The caudal vertebra is of large size and peculiar form. The centrum is considerably wider than deep, and considerably longer than wide. The posterior chevron articulations are small, and each is connected with each anterior by a strong rounded angulation. Between the latter the space is wide and slightly concave in transverse section, least so medially. A marked peculiarity is seen in the strong longitudinal ridge which divides the lateral surface of the vertebra into two nearly equal faces. The neural arch is elongate, the neural canal small: in section a short vertical ellipse. The articular face of the zygapophyses makes an angle of about thirty-five degrees to the perpendicular. The crest of the arch rises a half inch behind these into the very stout basis of the neural spine, the greater part of which, with the posterior zygapophyses, is broken off. The inclination of the base is about 65° to the vertical diameter of the bone. The articular faces are both slightly concave, as are the lateral faces which are separated by the lateral ridge.

	<i>In.</i>	<i>Lines.</i>
Length of centrum.....	4	6
“ basis of neural arch.....	2	9
Width posterior articular face.....	4	

		<i>In.</i>	<i>Lines.</i>
Depth	“ medially.....	2	8
“	“ laterally .....	3	3
“	basis neural spine.....		12
Transverse diameter	neural canal behind.....		10
Width between latero-inferior	ridges.....	1	9
“	vertical face of zygapophyses.....		11

There is a slight rugose protuberance in the position of the diapophysis.

The peculiarities of this vertebra indicate most strikingly the generic distinctness of this great reptile from the *Hadrosaurus*. It is true it presents some similarity in form to the terminal caudals of that genus and if it could be referred to that portion of the series, would indicate merely another and larger species of *Hadrosaurus*. It differs in form from these vertebræ, in its depressed instead of compressed form, and its lateral angulation. That it belongs to a more anterior position in the tail is evident from the very large size of the basis of the neural spine, and general greater development of the neural arch and zygapophyses, and the trace of diapophyses. Further, it is over four times the size of the terminal caudals of *H. foulkei*, while the remaining elements do not indicate any such extraordinary dimensions. A position a little behind the middle of the series would relate well to the other proportions.

This is another of those remarkable forms which the reptilian type developed in past ages. That it was herbivorous, and relied less on its tail for support than *Hadrosaurus*, appears probable. Large caprolites of the character of those of herbivorous animals accompanied the bones. They resemble somewhat those of the hog; one has a diameter of 3.5 inches one way, and 2 inches the other; extremity broad, obtuse. The proprietor of the pit told the writer that he had more than once seen large “hoofs” “and wide toe-joints” taken out during the excavation.

This species is different from the *Ornithotarsus immanis*, Cope, and belongs to a different genus. The shaft of the tibia in the latter is filled with cancellous tissue; in the present animal it is entirely hollow.

From the marl pits of James King.

#### HADROSAURUS, Leidy.

##### HADROSAURUS TRIPOS, Cope.

At a point about ten miles distant from the marl pit in which the *Hypsibema* was found, Prof. Kerr discovered a caudal vertebra of a colossal reptile, whose affinities are evidently near to the *Hadrosaurus foulkei*.

This vertebra is one of the distal, as evidenced by the entire absence of any trace of diapophysis, and its subquadrate longitudinal section, as well as by the small size of the neural arch and spine. At first sight it would appear to occupy a position between the thirtieth and thirty-sixth of the series; the former in *H. foulkei* has, however, rudiments of a diapophysis. Both its articular faces are distinctly biconcave. The large

size of the chevron articular face is as in the thirtieth, and the concavity of its lateral faces as in the twenty-sixth; in the thirty-sixth the sides are entirely plane. The round form of the neural canal, as well as lack of diapophysis, are points of resemblance to the thirty-sixth, but it is more than twice as long as that vertebra in the *H. foulkei*. In the thirtieth the neural canal is somewhat depressed and becomes more so as we advance towards the proximal part of the series. The small antero-posterior extent of the neural arch is much as in the thirtieth in *H. foulkei*, but the basis of the neural spine, which is broken off in this, as well as the odd species, is much more slight. It is so very thin and weak as to indicate either comparatively a slight development of the spine, or a very posterior position in the series. A weak lateral ridge marks the side of the centrum, which is below the middle line. It holds the same position in the thirty-sixth in *H. foulkei*, but is above the middle in the thirtieth and those anterior.

<i>Measurements.</i>	<i>In.</i>	<i>Lines,</i>
Depth centrum to summit chevron articulation...	5	
“ from neural canal without chevron face...	4	
Greatest width “ “ “ ...	4	9
Length centrum.....	4	3
“ neurapophysis .....	2	6
Width between anterior zygapophyses.....	1	3
“ of arch above.....	1	6
“ neural canal.....		10
Depth “ .....		10
“ basis neural spine.....		5

This specimen was procured from the marl pit of W. J. Thompson, Sampson Co., N. Carolina.

A second and much smaller vertebra from the pit that furnished the remains of *Hypsibema crassicauda*, belonged to a third individual, and possibly to this species. Its proportions would point to a position near the end of the tail, and its form is less elongate and compressed than those in that position in *H. foulkei*. Its neural arch is not coössified. The extremities are slightly concave, the general form subquadrate.

	<i>Lines.</i>
Length of centrum.....	20.5
Diameter extremity, (vertical).....	18.
“ “ (transverse).....	21.5
“ middle “ .....	15.

The first named vertebra pertained to an immense species, perhaps double the *Hadrosaurus foulkei*, in weight and bulk, should the general proportions of the two have been at all similar. In that case the length of the femur would be sixty-two and a quarter inches.

It will remain for future discovery to determine whether the species is the same as the *Ornithotarsus immanis*.

PLATE I.—*Hypsibema crassicauda*.

1. Caudal Vertebra of *Hadrosaurus tripus*, side. 1a. Articular face.
2. do. young? a. end, b. below.
3. *Eschrichtius polyporus*, side. 3a. above.

PLATE II.—*Hypsibema crassicauda*.

1. Humerus, distal portion, from below. 1a. From end.
2. Tibia shaft, from the side; 2a. from end.
3. Caudal Vertebra.
4. Coprolite fragment.

PLATE III.—*Hadrosaurus tripus*. *Eschrichtius polyporus*.

1. Fibula, lower portion; a. proximal end of fragment.
2. Outer metatarsal, inner side; 2a. proximal end of do.

PLATE IV.—*Mesosteras kerrianus*. *Clepsysaurus pennsylvanicus*. *Thecachampsia rugosa*. *Polydectes biturgidus*. *Belodon priscus*. *Diodon antiquus*.

1. *Mesosteras kerrianus*, periotic bones. 1a. Interior view; 1b. end view.
2. *Polydectes biturgidus*, crown of tooth, side; 2a. inner view.
3. *Thecachampsia rugosa*, crown of tooth, inner view.
4. *Clepsysaurus*, tooth, inside view; 4a. posterior view; 4b. section base; 4c. do. near extremity; 4d. base of larger sp.
5. *Belodon? priscus*, anterior tooth; 5a. posterior view of another; 5b. lateral view of a posterior tooth; 5c. edge of do.
6. *Diodon antiquus*, upper jaw front; 6a. do. from below; 6b. lower jaw from front; 6c. do. from above.

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*Stated Meeting, December 1, 1871.*

Present, ten members.

DR. EMERSON in the Chair.

A letter of acknowledgment (86) was received from the Society of Antiquaries, dated London, November 8.

Letters of envoy were received from the Pontifical Academy d. N. L., dated Rome, June 7, 1869; and from the Public Museum, at Buenos Ayres, dated July 12, 1871.

A letter was received from Mr. H. H. Leech, dated New York, Nov. 18, 1871, offering for sale the MSS. Fables of M. Lorin, of Paris.

Donations for the Library were announced, from the P. A. d. N. L. at Rome, the R. Institutes at Milan and Venice, the R. Observatories at Moncaliere and Turin, Signori Dorna, Biffi, Muoni, Buccellati, Ferraris, Gabba, Mussi and Denza; from the Public Museum at Buenos Ayres; the Editors of the *Revue Politique*, Old and New, the *American Chemist*, and from Yale College.

A photographic copy of the quasi coin described below, was presented to the Cabinet by Mr. Dubois.

An Obituary notice of Sir John F. W. Herschel, written by Mr. H. W. Field, of the Royal Mint, London, pursuant to appointment, was read by Mr. Patterson.